UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
WASHINGTON, D. C.
H. H. BENNETT, CHIEF

ADVANCE REPORT

on the

SEDIMENTATION SURVEY OF LAKE BENNETT

CONWAY, ARKANSAS

November 2-22, 1935

by

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Hydrodynamic Studies
Division of Research
SCS-SS-9
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ADVANCE REPORT ON THE SEDIMENTATION SURVEY OF LAKE BENNETT CONWAY, ARKANSAS

GENERAL INFORMATION

Location: State: Arkansas.

County: Faulkner. Sec. 33, T. 8 N., R. 12 W.

Distance and direction from nearest city: 22 miles north of Conway, Ark.

Drainage and backwater: Two small branches of East Fork Creek.

Ownership: Soil Conservation Service, U.S.Department of Agriculture.

Purpose served: Lake Bennett was built in the development of Bennett Park and serves (1) as a recreational lake and (2) as a basis for the study of reservoir silting in a drainage area subject to erosion-control measures. The park was named in honor of Dr. H. H. Bennett, Chief of the Soil Conservation Service.

Description of dam: The dam was built under the supervision of Col. Ralph A. Sturgeon, Associate Agricultural Engineer, of the East Cadron Creek Project. It is constructed chiefly of the local rock, a massive gray sandstone, upon which it rests, but has in addition a concrete and masonry core wall. The materials used in the construction were taken from areas adjacent to each end of the dam, these areas later becoming the spillways. Both spillways slope upstream from crest level to a depth of about 0.75 foot before joining the lake proper. The dam has the following dimensions:

Height	39 feet
Length	500 feet
Thickness at base	69 feet
Thickness at top	10 feet
Spillway elevation (above mean sea level)	488.74 feet
Upstream slope	1:1
Downstream slope	2:1

Date of completion: June 24, 1935. Average date of survey: November 12, 1935. Age to date of survey: 0.37 year.

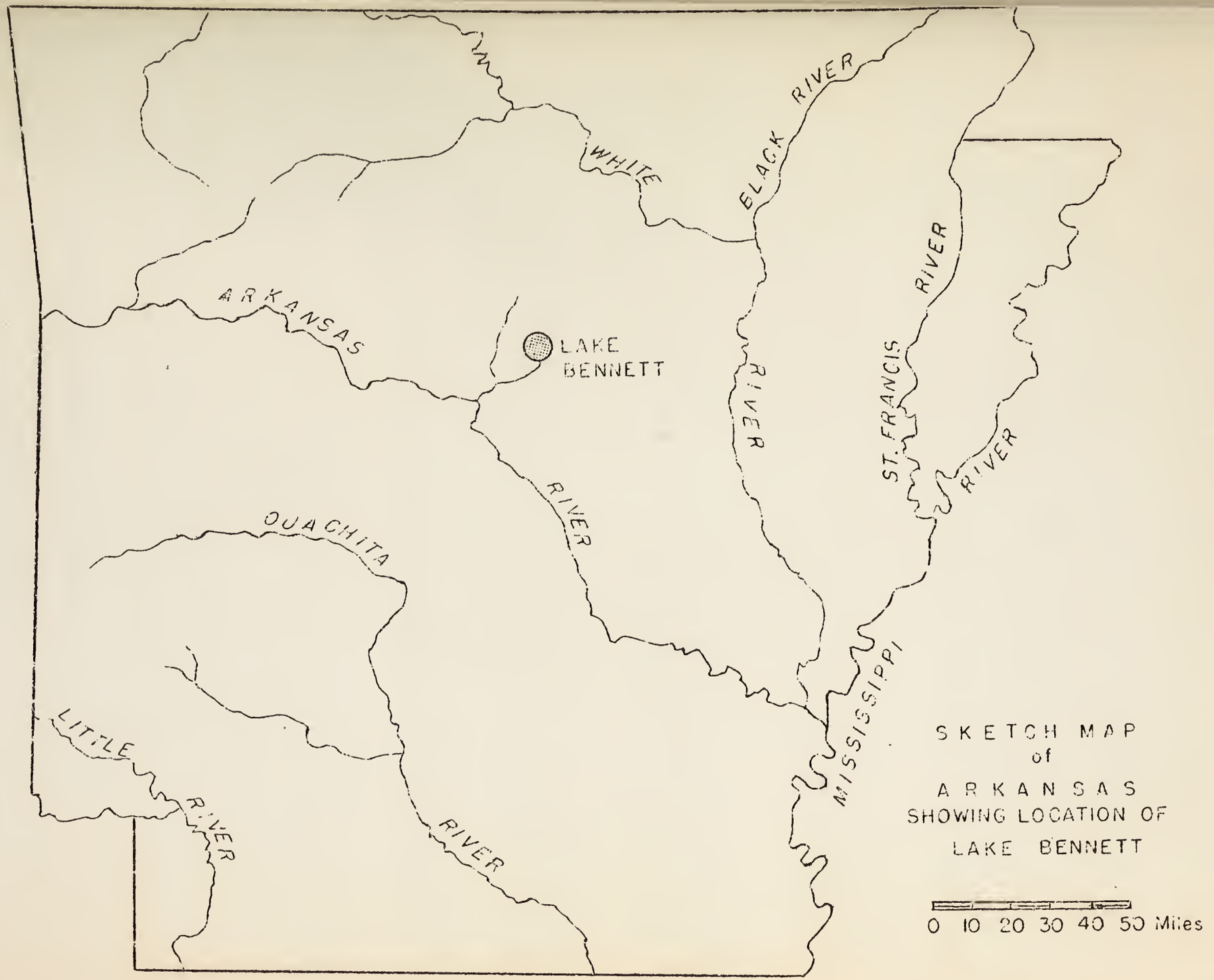
Length of lake (original and present): North arm 3,290 feet; west arm 2,435 feet.

Area of lake at crest stage (original and present): 36.90 acres.

Storage capacity at crest level:

	Acre-feet	Gallons
Original	492	160,318,200
Present	488	159,014,800
Loss due to silting	4	1,303,400

Area of watershed: 2,662.3 acres or 4.16 square miles.


WHITE
BLACK RIVER
ST. FRANCIS RIVER
RIVER
ARKANSAS
LAKE
BENNETT
RIVER
OUACHITA
RIVER
MISSISSIPPI
LITTLE
RIVER
RIVER
SKETCH MAP
of
ARKANSAS
SHOWING LOCATION OF
LAKE BENNETT
0 10 20 30 40 50 Miles

General character of watershed: The dam is just below the junction of two forks of a small branch which flows into East Fork Creek. Below the entrance of this tributary East Fork Creek runs south and west for a distance of about 15 miles before entering Cadron Creek, which in turn flows into the Arkansas River.

Lake Bennett lies within the area underlain by the Atoka formation, a member of the Pottsville series of Pennsylvanian age. The massive gray cross-bedded sandstone upon which the dam rests is overlain in this watershed by thin beds of sandstone and black shale, which grade upward into yellowish-brown quartzite of unknown thickness. The thin-bedded sandstones are not strongly cemented, so that weathering takes place with comparative ease. The resulting sandy soils are particularly subject to severe erosion.

The predominating soil series of the uplands is the Hanceville, which includes types ranging from coarse gravelly loam to fine gravelly loam. The valley soils, comprising chiefly the Conway, Enders, Pope, and Atkins series, range from coarse gravelly loams to silty clay loams.

The Lake Bennett watershed, comprising 2,662 acres, lies entirely within an area set apart for demonstration of erosion-control methods. As a part of the demonstration work about 1,300 check dams have been built to reduce and control gully erosion.

Land use of the drainage area is divided as follows: 61 percent forest, 27 percent cultivated, and 12 percent pasture or idle land. The cultivated area is devoted primarily to clean-tilled crops, chiefly cotton and corn.

Slopes in the Lake Bennett drainage area reach a maximum of 30 percent, but for the most part are between 10 and 20 percent.

Slight sheet erosion, involving the removal of less than 25 percent of the surface soil, is the most widespread erosion condition in the watershed. The prevalence of this relatively mild type of erosion is due to the protection afforded by an extensive woodland cover. In contrast, on most of the cultivated land and much of the pasture and idle land, erosion has been moderate to severe. Gullies have developed in scattered areas of the cultivated land and are found in most of the pasture and idle lands.

Mean annual rainfall: 46 inches.

HISTORY OF SURVEY

The survey of Lake B ennett was made by the Central Reservoir Party, Subdivision of Hydrodynamic Studies, Division of Research, during the period November 2 to 22, 1935. The party included Louis M. Glymph, Jr., Chief of Party, Elliott M. Flaxman, William G. Shannon, Harry L. Fischer, and Oscar D Price.

The range method of volume determination was used, and in

addition, the upper reaches of both arms were mapped on a 2-foot contour interval, so that the volume of such coarse delta deposits as might accumulate in these areas, and which are not easily penetrated by the spud, may be accurately determined in future resurveys. The reservoir basin has been contoured on a 5-foot interval by Col. Sturgeon before the lake was filled, but the contours were somewhat too generalized in the upper limits of back-water for accurate future silt determinations by the contour method. An excellent system of horizontal control which had been established and marked by concrete monuments during the earlier survey was used for the present survey.

All mapping was done by plane table and telescopic alidade on a scale of 100 feet to the inch. In addition to complete contour mapping of the upper arms, the crest line of the lake and a contour 2 feet above crest were mapped. The surface area of Lake Bennett was divided into 11 segments, of which segments 1, 5, 8, and 11 are bounded by only one range. In locating the bounding range for each of these four segments, care was taken to select that cross-section from which the slope was uniform to the upper end of each segment.

A slight divergence from standard methods 1/ was made in computing the original and present volumes of segment 1. As shown by the accompanying map, segment 1 was further divided into subsegments AB and CD. That portion of segment 1 bounded by range 01-02 and lines A and C is in the lake proper. Areas AB and CD are the spillways and are relatively shallow. The volumes of segment 1 were computed by assuming the end area through the axis of the dam to be equal to the end area of range 01-02. Since parts of the volumes so obtained are displaced by the dam, the displacement volumes were computed by the pyramid formula and subtracted from the computed volumes of segment 1.

Volumes for subsegments AB and CD were computed by using lines A and C as ranges and assuming that these have an average water depth of 0.75 foot. From these lines the slopes are uniform to lines B and D, the actual spillway crests, the end areas of which were taken to be zero. The lengths of lines B and D were scaled from the map and used in calculating the average water depth of the adjoining segment. That is, in determining volumes of subsegment AB the end areas and lengths of both lines A and B were used. Subsegment CD was treated in the same manner. The sum of the two subsegment volumes was added to both the original and present volumes of segment 1. No silt was found in either subsegment.

CHARACTER, DISTRIBUTION, AND ORIGIN OF SEDIMENT

The 4 acre-feet of sediment deposited in Lake Bennett is a mixture of silt and fine sand. Owing to the small surface area of the lake and the relatively high velocities of flood waters, the greatest accumulation of sediment has occurred, not near the head of backwater,

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1/ Eakin, H. M., Silting of Reservoirs, U. S. Dept. of Agriculture Tech. Bull. 524, pp. 128-141, 1936.

but between the dam and the junction of the two arms of the lake. The maximum silt thickness on the 5 ranges nearest the dam is 0.7 foot, and the average thickness for the reservoir is less than 0.2 foot. On the northeast arm practically no sediment was found above segment 9, and on the west arm the deposit decreases in maximum thickness from 0.7 foot on range 05-06 to 0.2 foot on range 07-08.

Most of the sand and other coarse material derived from erosion in the watershed has been deposited above the reservoir during the 4½ months of its life. Check dams constructed in the tributary channels have played a large part in retaining this heavier load.

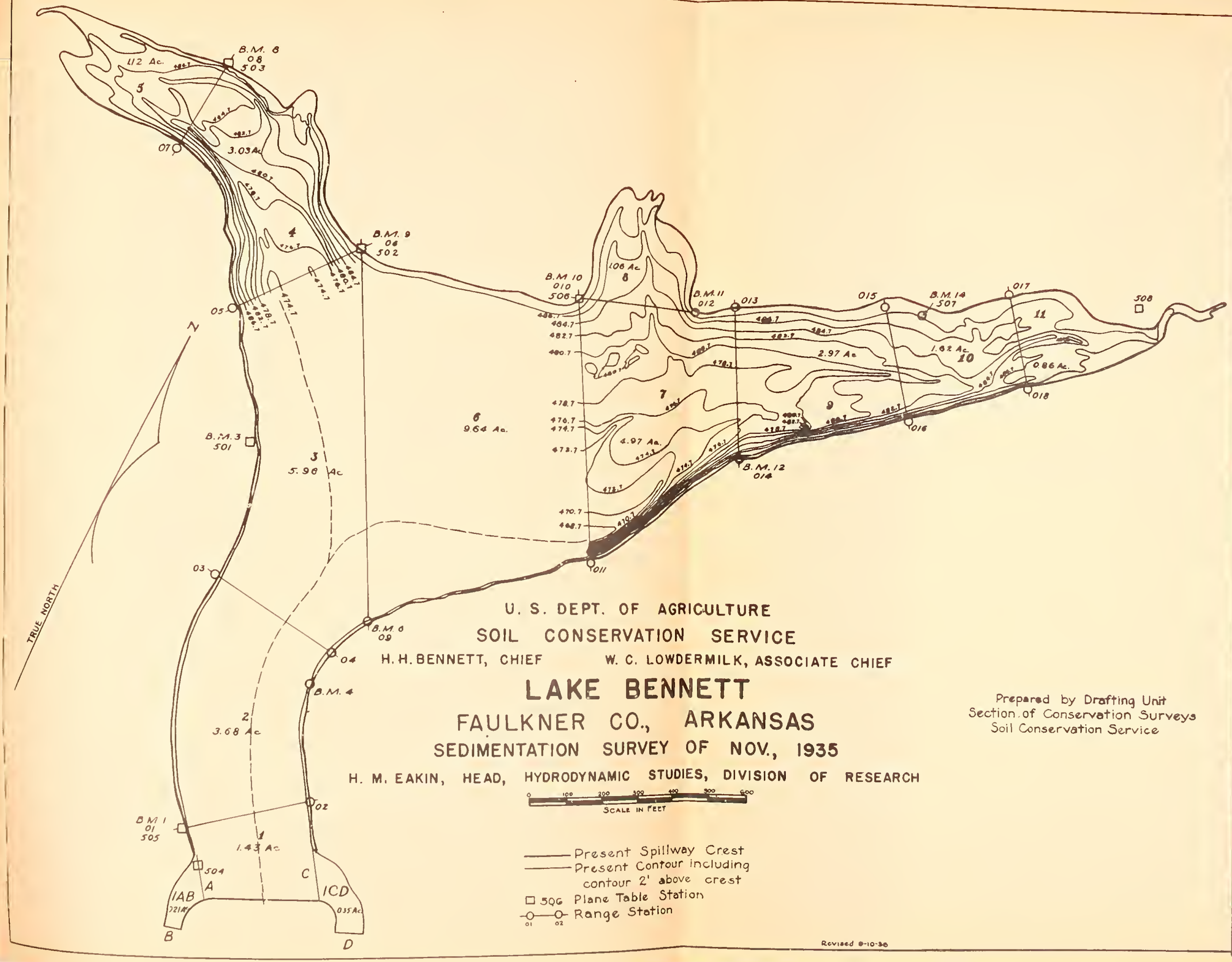
It is the opinion of Col. Sturgeon that a large part of the silt now lying in the reservoir was deposited during heavy rains which occurred before actual storage began. This survey, however, furnished no basis for determining the extent to which this may be the case. Aside from this, in considering the rate of sedimentation two limitations on the survey data should be taken into account. First, the influence of erosion-control measures in the reservoir watershed, completed according to the demonstration project working plans since the reservoir was built, should become progressively more effective in reducing sediment output from the watershed. Second, a period of 4.5 months is too short in any case to give a reliable indication of the silting rate to be anticipated. A period of several years, at least, will be necessary to establish an average rate of sediment output based on variation in climatic and vegetative factors and average effectiveness of erosion-control measures.

The principal value of this survey, therefore, has been the establishment of an accurate reservoir capacity figure as a starting point, against which future periodic surveys will measure the trends in sediment delivery from the watershed and, consequently, the progressively increasing effectiveness of erosion-control measures.

The following tabulation is a statistical summary of data relating to Lake Bennett, near Conway, Ark.

	Quantity	Unit
Age: 1/	0.37	Years
Watershed:		
Total area	4.16	Square miles
Reservoir:		
Original area at crest stage	36.90	Acres
Present area at crest stage	36.90	Acres
Original storage capacity	492	Acre-feet
Present storage capacity	488	Acre-feet
Original storage per square mile of drainage area	118.3	Acre-feet
Present storage per square mile of drainage area	117.3	Acre-feet
Sedimentation:		
Delta deposits	None	
Bottom-set beds	4	Acre-feet
Total sediment	4	Acre-feet
Accumulation per year average	10.8	Acre-feet
Accumulation per year per 100 square miles drainage area	259.6	Acre-feet
Accumulation per year per acre of drainage area	176.7	Cubic feet
Or, assuming average weight of 1 cubic foot of silt is 100 pounds	8.8	Tons
Depletion of Storage:		
Loss of original capacity per year	2.20	Percent
Loss of original capacity to date of survey	0.81	Percent

1/ Date storage began: June 24, 1935.
Average date of survey: November 12, 1935.



U. S. DEPT. OF AGRICULTURE

SOIL CONSERVATION SERVICE

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LAKE BENNETT

FAULKNER CO., ARKANSAS

SEDIMENTATION SURVEY OF NOV., 1935

H. M. EAKIN, HEAD, HYDRODYNAMIC STUDIES, DIVISION OF RESEARCH

0 100 200 300 400 500 600

SCALE IN FEET

——— Present Spillway Crest

——— Present Contour including contour 2' above crest

□ 506 Plane Table Station

—o—o— Range Station

01 02

Prepared by Drafting Unit
Section of Conservation Surveys
Soil Conservation Service

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